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# ARN-1 Radio-less Allstar Node

The ARN-1 radio-less node allows direct wired or wireless Internet connection to the Amateur Radio Allstar network as well as Echolink, IRLP, and other digital modes. It is an all in one communications solution for fixed or mobile locations. Some of the features include -

- Raspberry Pi 3B+ for 2.4G or 5G wireless connectivity
- Powerful 60W rated class D audio amplifier
- DTMF Microphone with compression and limiting
- Indicators for power, COS, PTT, and heartbeat
- Battery backup shutdown
- +12V operation
- Small, lightweight and portable

Circuit Description

The ARN-1 is a completely self contained Allstar node. It uses the Raspberry Pi board and pre-installed HAMVOIP software to offer you the best Allstar experience possible. Current HAMVOIP software also offers Echolink, IRLP, and soon DMR and other digital bridging modes. The ARN-1 runs from any clean 12V DC source and is supplied with a 12V wall wart. It could also be used with a vehicle 12V system. Internally the audio amplifier runs on the 12V bus. A power supply converts the 12V to 5V to run the Pi and other peripheral components. A power control board along with a 9V rechargeable battery monitors the incoming power and shutdown status of the Raspberry Pi allowing seamless and safe shutdown by just interrupting the incoming power or shutting the system down manually.

The microphone circuit uses a unique arrangement to develop the DTMF required to control Allstar. The supplied Yaesu microphone sends different voltage level signals with each DTMF button to an Arduino processor that maps the levels and creates the correct DTMF tone. This also also allows monitoring of the DMTF signals in the speaker. A special compressor/limiter chip is also employed to keep the microphone levels from over driving the A/D converter on the FOB. This is a requirement for good audio when you connect a microphone directly to the FOB and it works very well.
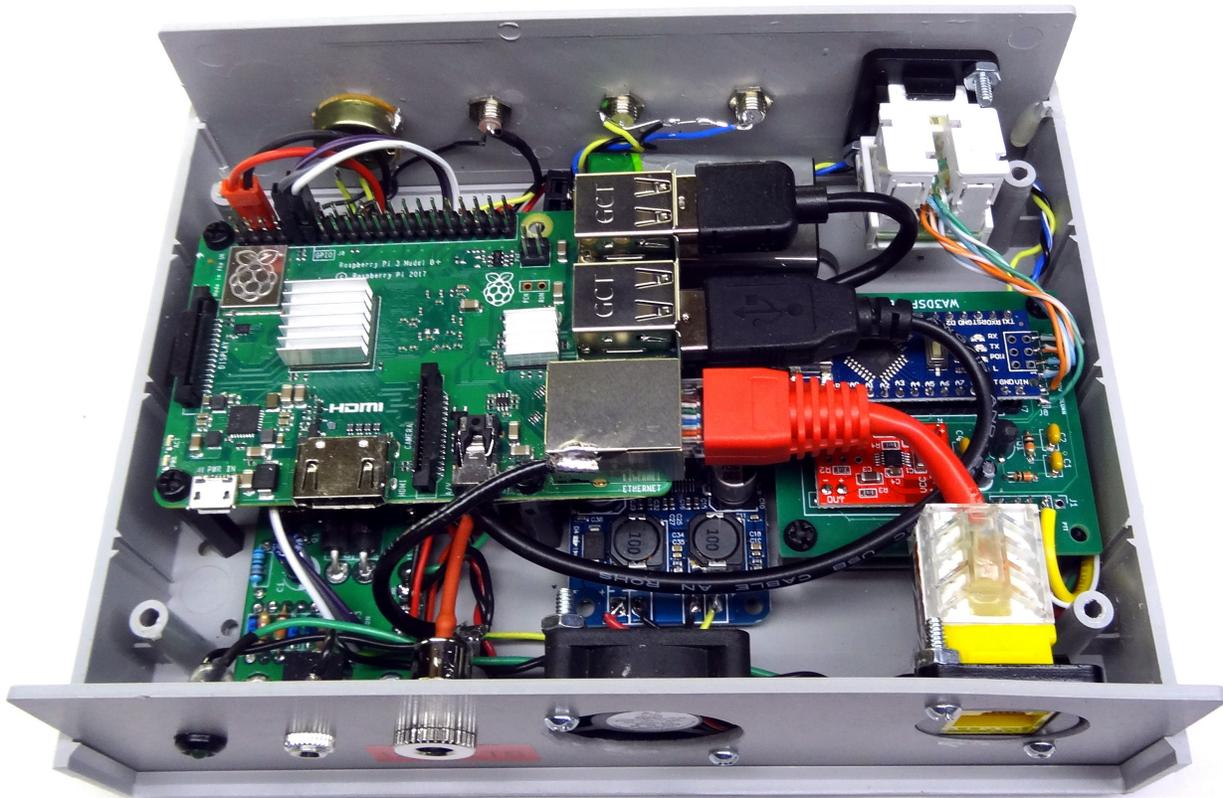
This photo shows the internals of the radio-less node. To the left is the Raspberry Pi 3B+. Underneath the Pi is the power control board and to the front under the Pi (not visible) is the 12V to 5V power board. In the middle under the Pi is the 60W Class D Audio amplifier. On the right is the Arduino with the compressor limiter mounted on a carrier board. Underneath this is the ARA-1 Ver. 2 USB FOB. In front, visible past the USB connectors and under the front panel LED's is the 9V NiMh battery used for shutdown.

Things you will need to get started

Amateur Radio License – if you are using this with Amateur Radio Allstar
Access to Internet via wired Ethernet connection (not wireless to start)
Registered Node Number from allstarlink.org
Node Number Password from node information at allstarlink.org

First steps

You probably have already registered at allstarlink.org and received a node number before getting your radio-less node but if not you must do this **BEFORE** continuing the setup process. If you already have setup a server "on paper" at allstarlink.org and have a node number assignment and password then you can skip down to setup.

Before you can use an Allstar server it must be registered at allstarlink.org. Bring allstarlink.org up on a browser and register with your call and a password of your choice. The registration process ensures you are a ham and usually happens fairly quickly. This process is accelerated if you have an email listed on qrz.com.

Once you can log into the allstarlink.org web site using your call and password you go to your profile and check the item that you want to be a sysop and submit it. At this point the banner will change and you will see

an option to create a server. Go through the setup for the server which asks for a name and location. Use the google map to pinpoint your location. It is a very simple setup and you can change things at a later time if you desire. Once you have established a server you select the drop-down to request a node number. There is no need to make any comments, just submit it. You should receive an email in 24 hours or so with your new node number. You can also check at allstarlink.org to see if the number has been assigned. Before it is assigned it says pending. Once assigned you can find the node password under the server and node number with the mouse. The password is a 12 character mixture of numbers and letters. Note the old system used 6 numerics for the password so if you are using an older node number this would still apply. The node number and password are required for your local setup. Unless you are using your radio-less node as a private node or in a non-amateur application you cannot set it up until you have an assigned node number and node password.

Connection and Setup

The ARN-1 comes with a power supply and microphone. The user must supply a speaker with a **mono** miniature phone connector. Keep in mind that this unit has more than ample audio output. It could drive you out of a room at full volume. Therefore if you want to run it at high volumes the speaker must be capable of the power supplied to it. You could easily blow out a small speaker with the volume turned way up. The node uses a 60 watt capable class D bridged amplifier. **NEVER ground or connect either side of the speaker connector to anything else or short the speaker connections together!** Doing so will damage the amplifier.

The startup connections required for the ARN-1 are a wired Ethernet connection, a speaker, and 12V power. The microphone plugs into the front panel and the Ethernet, speaker and power on the back panel.

Once all the connections are made power can be applied. Make sure there is a speaker and Ethernet attached when you supply power. Note that the microphone light is delayed until the boot process applies USB power. The IP address that is provided by your router will announced over the speaker. You will use this address to access and setup your radio-less node. Record this IP address for later use. If an IP address is not announced or is blank it is not finding an Internet connection. Check that it is properly connected to your LAN.

You will need to access your node from another computer on your LAN. This is typically done with ssh or a program that uses ssh like putty for Windows. Putty is a free download on the Internet. You can Google "putty download" but make sure you get it from the official site as as shown in this link -

https://www.putty.org/

Front panel showing the RJ11 microphone connector, PTT (blue),
COS (yellow), and power (red) indicators and the volume control.
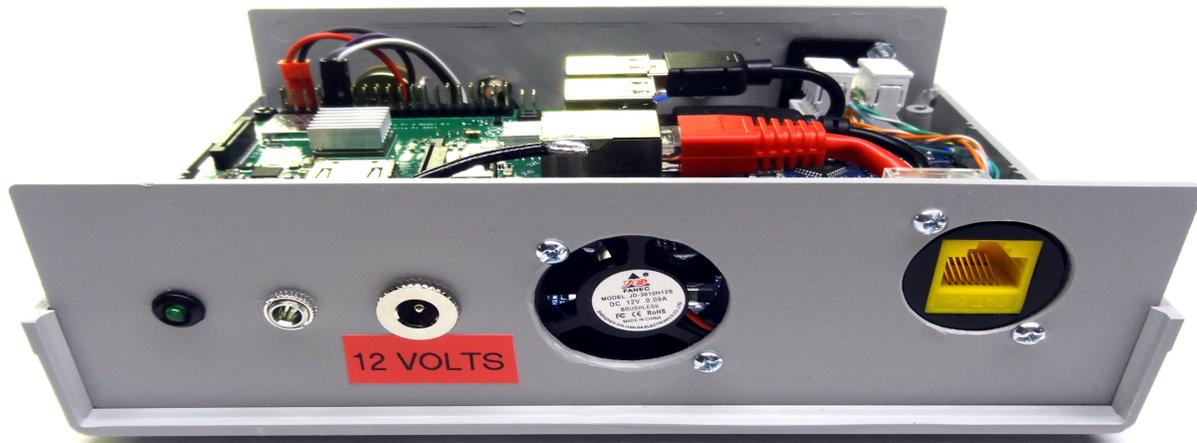
*Rear panel showing hearbeat (green) LED, miniature Speaker Jack,
12V power input, cooling fan, and Ethernet connection.*

NOTE – You node is pre-configured but not setup for your node unless you specified for us to do that and you supplied the required information. If you need to setup your system from scratch because you started with a new SD card not configured by us please see the instructions on how to do that at the end of this document.

You need to login to your radio-less node for setup and later as needed configuration changes. There is no external HDMI connector and while you could remove the cover and connect directly to the Pi with HDMI and USB for a keyboard and monitor it is highly recommended you do not do that unless absolutely necessary. The preferred way to access your node is via SSH over its Internet connection using Putty or another ssh method.

Putty is a simple program that allows you to connect to your Pi via your LAN. Remember you must hardwire connect to Ethernet for the initial setup of your node. Use a cable with RJ45 connectors to connect the Ethernet port on the radio-less node to your router or a connection on your LAN. Enter the IP address given on the speaker at startup and port 222 and select connect. Say "yes" to any confirmation message.

If for some reason you do not get the IP address at startup it should also be displayed on your routers connected map. Log into your router and look for a hostname of "alarmpi" or if pre-setup your node number and call. The IP address associated with it will be the IP address assigned to the Pi. It will probably be in the 192.168.x.x or 10.0.x.x range.

Unless your radio-less node was pre-setup, in which case you would be given login instructions, the default login is **root**   and password is **root**   which is changed to a password you select during setup.

Setup

Your node is shipped with an SD card programmed with the hamvoip.org Allstar code and installed in the Pi. Unless you specifically requested to have it pre-setup with your specific information it is your responsibility to do that. Setup is very easy and takes no more than 10 minutes to do.

Once logged in

After logging in the system will ask a number of questions. For many of the questions you can select defaults but for others you will need to enter specific information. All of the setting have explanations. Go through the entire setup. If you make a mistake and want to run the setup again you can cancel (control C) and at the Linux prompt type firsttime.sh to restart the setup program. If you find yourself in the menu you can select item 9 – "start bash shell interface" to get to the Linux prompt.

The setup script will guide you through the entire setup process. The first thing it does is update your software to the latest version. This is an important step and you should say yes and update before continuing the setup process.

Then it will ask a series of questions to complete the setup process. Before you proceed with the setup have the following things ready -

- Your assigned node number
- Your node password (6 digit for older node assignments and 12 character for new)
- Your new login password for your Pi which you select.

Remember that if you want to change something in the setup you can start over by running the script **firsttime.sh a**t the Linux prompt. It will remember most of your entries from the last time but it also over writes any manual entries you may have made after setup.

Safe passwords

A note about login passwords. It is important to use a strong password. We suggest 8-10 characters of mixed upper/lower, numbers and special characters. Don't use your call. **Write down your login password somewhere. If you forget it you will not be able to login to your Pi and you will have to re-image and re-setup your node!**

Hostname

For your convenience we recommend using a hostname that makes sense. The default is alarmpi - when asked erase that and use your call-node_number - ex. W3XYZ-40000. Using a distinctive hostname allows you to identify your node when logging in especially if you have multiple servers. It tells you what you are logged into.

Simpleusb Setup

The Allstar image supplied with your radio-less node has been pre-configured with the proper simpleusb settings. All you should need to do is check the receive and transmit audio levels as described below.

Setting Audio Levels

Audio levels have been preset but should they need to be adjusted here is the procedure. From the main menu select the simpleusb-tune-menu item. In the sinpleusb-tune-menu screen select Item 2. This is the level setting for the microphone inout to your radio-less node. This is labeled RX audio. There is a bar graph showing the level and when you speak in a normal tone and distance it should peak to about 5khz with just an occasional slight excursion above this level on peaks. You should not close talk the Yaesu microphone as it will tend to cause breath noise "popping." To avoid this talk at about 2 inches away from the mic or to the side of the mic and set the level appropriately. A typical level for the ARN-1 is 450-500.

Item number 3 is audio you hear FROM your radio-less node. This is generally set to a level of about 850 allowing the front panel volume control at very high level of audio at its maximum setting. You can however lower this value to limit the maximum volume. This would be a good idea when using smaller speakers that would distort or even be damaged by extremely high volume levels.

The simpleusb-tune-menu also has an option to echo your voice back so you can check your audio. It is item C on the menu. Set it on and key a radio talking to your node and it records your voice and when you unkey it plays back. This will give you an idea of how you sound to others. Be sure to turn it off when you are done.

Before leaving the simpleusb-tune-menu be sure to save your settings using item W then 0 (zero) to exit.

Some Additional Notes

While we tested the SD card to make sure it boots and runs should you have any problems you can rewrite the card from the download image at the hamvoip.org website. However if you do this you will need to go through the entire setup process including simpleusb setup as nothing would be pre-configured. It would be a good idea to make a backup copy of your SD card and storing it to avoid having to do this. If you ever do need to perform a complete setup see the "Complete Setup" procedure at the end of this document. More information is available at the hamvoip.org website including howto's and additional features for your node. You should also join the arm-allstar email forum link at the website for the latest information.

Commanding your Node

To use your node you will need to issue DTMF commands from the microphone. All Allstar commands begin with the star "*" character. Here are a few of the more important commands. These and other commands can be entered via the mic and DTMF, in Supermon, or in the Asterisk client.

*A1 Say Local IP
*A3 Say Public IP
*B1 Halt The System
*B3 Reboot The System
*B6 Restart Asterisk
*80 Your ID
*81 Time 12 hour
*82 Time 24 hour
*3<node number>   Connect to node
*1<node number>   Disconnect from node
*73<node number> Connect to node permanent
*71<node number> Disconnect from node permanent
*76 Disconnect all nodes

Port Forwarding

Your Allstar node will make outbound connections without any special configuration but if you want to allow other nodes to connect inbound "TO" you and also add the ability for ssh login using putty from outside of your LAN or remote Supermon management you will need to add port forwarding in your router.

Routers are in essence are firewalls as they restrict incoming traffic unless specifically allowed. To allow incoming traffic for your node you need to do several things. First you should make the IP address your router assigns to your Pi server (ARN-1 radio-less node) permanent. Most all routers allow this. It is sometimes

called address reservation or static DHCP. This makes your router assign the same address each time your server comes online. It knows your Pi's hardware address and even if you took it offline for a long time or installed a different operating system it would always assign the same address to that Pi.

Once you have a known permanent IP address you can add port forwarding. To allow incoming connections go to your routers port forwarding setup and add this rule -

4569 UDP to the IP address of your Allstar server (radio-less node)

This can be labeled AllstarIAX. The label is just for reference. The port 4569 shown is the default port. If you changed this in the setup and at allstarlink.org you must change it in your port forwarding also.

To allow ssh from the Internet add this rule -

222 TCP to the IP address of your Allstar server (radio-less node)

This can be labeled AllstarSSH.

The 222 port is the default. If you changed this in the setup then use the same port here.

Port forwarding is optional and you can leave it undefined to restrict incoming connections if desired.

Note if you are using the radio-less node in a portable setting and accessing the Internet with a hotspot, IP address reservation and port forwarding would not apply. Using this type of connection in most cases you can only make outbound connects without special provisions like a VPN or static hotspot IPaddress.

Setting up WIFI

Once you have setup your node using the wired connection you can go wireless if you desire but it is always better to use a wired connection if you have one available. Mobile (hotspot) connections of course would be wireless. To setup wireless login and use the main menu item 7. The Software will scan for access points and you can select one of your choice. It will scan both the 2.4G and 5G bands and in general where available the 5G band is preferred due to crowding and interference on the 2.4G band.

It will then ask for the pass phrase (password) for the access point you select. The access point could be your local router or a phone hotspot, or WIFI at another location. Note that hotel or business WIFI will usually not work as it requires a web page login. After selecting the access point follow the directions and select reboot and immediately remove the Ethernet wired connection. Your node should come up on the WIFI connection.

Note that if you know the SSID and passphrase there is an option to set them manually without scanning.

Never have both WIFI and the wired connection active at the same time. If you want to go back to a wired connection plug in the Ethernet connection and turn off the WIFI using menu item 7 then select 2 and 2 again to disable WIFI. **NOTE that your WIFI IP address will be different** than you wired address as the Pi supplies a different MAC or machine address to the router. So if you plan to use WIFI you must setup the reserved IP address and port forwarding for that address. It is best to decide on either wired or wireless in a fixed setting and stick with it as you would have to make these changes when switching back and forth each time.

Shutting Down the Radio-less Node

The ARN-1 Radio-less node does not have a power switch. It boots up and is operational in about 20 seconds after power is applied. Because it includes a battery backup at power loss you can safely just remove power either with an external switch or by pulling the power plug on the back. Doing so will send a signal to the Pi which it will annunciate to you over the speaker that it is shutting down. Once the shutdown process is complete the backup power will be shutdown. Reactivating the the incoming 12V power will repeat the boot up process. The user also has the option of manually shutting down with DTMF or logging in via ssh. Using DTMF the command - *B1 - starts the shutdown process. Using ssh the menu item to "Perform System Power Down" can be executed. Because the internal 9V backup battery is only charged when 12V power is applied it is important to have power applied for enough time to recharge the battery whenever possible.

Maintenance

You radio-less node requires little maintenance. It is important to keep your software up to date which can be easily done using item 1 of the ADMIN menu when you log it. Never power down or stop an update. Always wait until it finishes.

Your radio-less node includes a heartbeat LED on the back panel. It was installed there because it might be annoying to see a steadily blinking light on the front panel. Once Allstar boots this LED indicates all is working fine when it is blinking at a steady rate. If this LED should go steady lit or go out it indicates an Allstar problem and your node will not be working. If this is the case then you will need to reboot by removing power and waiting for the power LED to go out and then reapplying powering to boot back up.

The backup battery is a common rechargeable 9V NiMh battery. It is slow charged when the node is turned on. The node uses battery power for about 20 seconds during the shutdown period. As long as the radio-less nodes on time intervals are not too short and you are not doing a lot of on off cycling of the power the battery charge should be fine. It is best to leave the node running whenever possible rather than constantly turning it on and off. If you are using it in a vehicle and you are constantly starting and stopping your vehicle it might be best to run it from a constant 12V source rather than on and off with the ignition. The average current draw is less than one ampere so leaving it run for an hour or so would not run down a good car battery. Just be sure to disconnect it when using it in a vehicle when you are done for the day.

If you radio-less node requires service it is best to not take things apart unless you know what you are doing. Let us know what the problem is and we will try to resolve the issue via email or on the phone. If the problem cannot be resolved the unit can be shipped back to us for repair.

The microphone is a user replaceable part which we can supply. Replacements can be purchased from us or directly from the Internet. Just make sure you use the same microphone model. You can also get just replacement cords for the microphone if necessary in the future. Only use the supplied microphone model. Plugging in a different model microphone could damage your radio-less node.

The supplied power adapter is also replaceable. In a fixed location you can also use any good source of 12V power at about 2 Amps. Make sure the polarity is correct! The center conductor of the barrel connector is positive. There is no internal fuse or reverse polarity protection in the radio-less node so it would be a good idea to fuse the incoming power when it is use from a high current source like a car battery or shack power supply. As noted earlier NEVER ground either side of the speaker leads!

The Arduino processor is factory programmed and should **not** need attention. If it does need reprogramming it can be done in place. The procedure is detailed in "Complete Setup" item 6 below.

Your radio-less node includes a small fan and ventilation holes on the bottom of the case. **Do not block these holes** and ensure that the fan is running and unobstructed when power is applied. Be especially careful when operating in high ambient temperatures that there is proper ventilation. The fan does not run during the backup battery shutdown period.

Complete Setup

Your node comes pre-configured and the **only time** you will need to follow this procedure is if you installed a new virgin SD card in the future. The ARN-1 radio-less node requires special setup parameters to function properly. If you previously made a backup of your original SD card after your ARN-1 was configured and later used it you would **not need** to perform these steps. Here is the procedure for setting it up from scratch. **Again this is only if you are creating a new SD card.** Some of these steps can be skipped where noted if that procedure has already been done.

1. Download the latest hamvoip image from hamvoip.org and burn it to an SD card. Remove the four screws and top cover form your ARN-1. Carefully remove and replace the SD card. You may need to you a small pair of needle nose pliers to remove it.

2. Connect a wired Internet connection, speaker, and microphone to the ARN-1. Then apply 12V power. Turn the volume up and listen for the IP address to be announced. Write down the IP address.

3. Using putty or an ssh program connect to the ARN-1 at the IP address and port (222). Login using the default user/pass of root and root.

4. Cancel the setup by saying NO to the questions which will bring you back to the ADMIN menu. Select item 1 and perform the update by answering yes.

5. When the update is done select item 9, start bash shell.

6. Program the Arduino. This step may not be necessary if your ARN-1 was previously setup but it does not hurt to do it again. Type -   **arduino_write.sh /usr/local/hamvoip-firmware/radiolessYaesuMic.hex**
You can cut and paste this command. When executed it will program the internal Arduino processor. This only takes a few seconds and it should complete successfully.

7. Edit the allstar.env file. Type at the Linux prompt - nano /usr/local/etc/allstar.env
Edit the following lines and **remove the #** at the beginning of these two lines in the file -

#export SETUP_SIMPLEUSB="disabled"

#export RPT_TEMPLATE_FILE="rpt.conf-arn_tpl"

Save the file using 'control x' and exit.

8. Restart asterisk -   type at the Linux prompt - astres.sh

9. Perform the entire setup using your node parameters by typing at the Linux prompt type - **firsttime.sh**
Using the setup section above as a guide go through all the setup selecting your parameters as normal.

Note that you can either set **duplex=1 or duplex=3**.   The advantage of duplex=3 is that your ARN-1 becomes full duplex and you can hear others transmitting while you talk avoiding doubling and you can also transmit and control your node over others transmissions. This can always be changed later by editing the rpt.conf file.

10. When the setup is complete run the script to start special ARN-1 features. These items are probably already set but again it does not hurt to set them again to make sure. Run the following script by typing at the Linux prompt -

/usr/local/bin/update_COS-radioless.sh

Answer yes to all questions.

11. If you have not already done this at the ADMIN menu select simpleusb-tune-menu and select and set or check the following -

Item 2 – RX level - set to 450

The RX level of 450 should satisfy most situations but you can check it by observing the bar graph. When you speak to the side of the mic it should peak up to 5khz. Change it as needed.

Item 3 - TX level – set to 850

The TX level can be adjusted down to set the max volume. The ARN-1 is LOUD at full volume and in many cases you may want that but if you are using a small speaker and you don't want to blow it out at full volume you can change this setting to a lower value.

Item H and Q - Turn off (disable) both PL and DCS filters.

Item J is by default usbinvert and should stay that way as should the other values

Make sure you use the W command to write your changes. Then 0 (zero) to exit.

13. Reboot and you should be all setup.

Thank You

Thank you for your purchase and we hope you will enjoy your new Allstar radio-less node. We are here to help you should you have any questions about your radio-less node. Allstar is an extremely powerful system which has many configuration possibilities and can also be directly used as a repeater controller. This quick start guide is just to get you started and on the air. See the hamvoip.org web page for many howto's and additional information and be sure to sign up for the email forum. Your radio-less node is online updateable and updates are announced on the forum periodically. Login to your server and select item 1 on the menu to update. **It is important to keep your server updated.**

For orders or technical assistance contact George, WB3DZZ -   TechnoByGeorge@gmail.com

Important Links

https://allstarlink.org - Node registration, node information
https://hamvoip.org   - Software download, howto's and general Allstar information